edge at what may be a new angle to some one else who may thereby perceive a generalization or means to discover one. This, which seems to be the purpose of discussion, will be served as well even though I may have fallen into errors far more grievous than the apparent one that has occasioned this communication.

Horatio Hughes

THE TRUE SOIL SOLUTION

Just recently, Dr. C. B. Lipman has published[1] a preliminary paper describing a "new method of extracting the soil solution," by subjecting the soil to a maximum direct pressure of 53,000 pounds to the square inch. This preliminary article describes briefly the apparatus used in obtaining this enormous pressure and claims for this new method the "obtaining of the soil solution *as it exists*[2] in relatively thin films around the soil particles. The procedure is rapid, clean and of high efficiency. With further improvements in apparatus which we now are planning, the method should supplant all other methods known to-day, including even the Morgan procedure." The fault found with the Morgan method is that it is "laborious and slow, and introduces the factor of oil which complicates and renders it extremely time-consuming and untidy."

Let us look at the important points Dr. Lipman claims for his direct-pressure method.

> It allows of the direct determination of the concentration of the soil solution, and of the amounts of each of the solutes contained therein.

The physical chemist is familiar with the fact that pressure is a considerable factor in influencing solubilities and it does not seem logical that a method employing such enormous pressures could obtain the soil solution "as it exists" in the soil without upsetting the whole physico-chemical equilibrium of the real soil solution; its specific gravity, viscosity, surface tension, osmotic pressure, specific conductivity and its chemical composition would all suffer more or less of a change which would combine to render the solution worthless to the plant physiologist or to the plant physiological pathologist from a scientific point of view. The reason that the soil solutions obtained by other methods are at fault is largely because the water added in extracting the soil changes the solubilities of certain of the ingredients. The van Suchtelen-Itano paraffin-oil displacement-pressure method described by Morgan[3] was worked out carefully with just the opposite idea in mind, *i. e.*, to subject the soil to *as little pressure as possible* so as to preserve intact the physico-chemical equilibrium of the solution obtained. To this end the most inert oil was carefully selected as the displacement medium and pressures not exceeding 500 pounds per square inch were employed for forcing the oil into the soil. The preliminary tests[4] of the paraffin-oil displacement-pressure method, run by van Suchtelen and Itano before extensive work was done by these investigators and by Morgan, show that the inactive paraffin oil when brought into intimate contact with the soil solution did not change the electrical conductivity, chemical composition nor surface tension. The solution is literally pushed out of the soil by the inert oil, only sufficient pressure being used to force the viscous oil into the soil.

The oil-pressure method is somewhat time-consuming, laborious and untidy, but common workmen after being carefully instructed can do this work under the supervision of the trained scientists; again, not one but a battery of as many cylinders as desired can be used to obtain sufficient quantities of solution in a minimum time. However if Dr. Lipman's above contentions did hold true in every respect the end in view, *i. e.*, the obtaining of a solution representing *most nearly in all re-*

[1] Lipman, C. B., "A New Method of Extracting the Soil Solution," Univ. of Calif. Publ. in Agr. Sciences, Vol. 3, No. 7, pp. 131–134, March 15, 1918.

[2] Italics ours.

[3] Morgan, J. F., "The Soil Solution Obtained by the Oil Pressure Method," *Soil Science*, Vol. II., No. 6, 1917, pp. 531–545, Pl. 1.

[4] Report of the Bacteriologist, 26th Annual Report of the Michigan State Board of Agriculture, pp. 152–153.

spects that of the actual soil solution, should be the first consideration.

To the soil bacteriologist the solution obtained under great pressures would be of doubtful value. Many bacteria are destroyed by high pressures (25,000 to 100,000 pounds). In fact high pressures alone have been employed successfully in the sterilization of fruits and vegetables.[5] Studies of the microorganisms surviving these enormous pressures would be probably only a matter of curiosity and of no immediate value or utility.

It seems that Dr. Lipman should have made a thorough comparative study of the soil solution obtained from the same soils by the two methods under discussion before he could be justified in making the statements set forth in his preliminary article.

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DRAWINGS ON LANTERN SLIDES

PROFESSOR GUNTHORP'S letter in SCIENCE for April 12 in regard to drawings on lantern slides seemed to the writer to be an attempt to solve the problem of writing upon clear glass when the ordinary coated slides were not available. The letter by Mr. Benton in the issue for May 17 goes further into the solution of this problem, and the suggestion of using india ink is a good one, but the idea of pasting paper to a slide to secure a purchase for the foot of a compass would lead one to suspect that the use of coated glass had not been tried. Even though this supposition is in error the use of ordinary unexposed lantern slides, fixed in the dark room, or of old slides reduced by successive immersions in "hypo" and Farmer's solution, may be new to some and is worthy of mention. The transparency of the prepared slide is all but perfect, the coated side can be written, drawn or ruled upon at will, areas can be shaded or colored, errors can be removed by the simple expedient of scratching away the gelatin (and the remaining scar is surprisingly insignificant when the slide is thrown upon the screen) and dividers or compass can be used without danger of slipping. In writing, the finer and firmer the point, and the less ink, the better, as a thick line will crack up into a mosaic; and experience has shown that ordinary fountain pen ink is much less liable than india ink to crack in this way or to "ball" at the ends of the strokes. Waterproof inks must be used, however, if the slides are to be wet. If it is desired to render large areas opaque, and it is impracticable to use successive thin coatings, cover them with india ink, preferably using a brush, and when the surfaces have dried and cracked cover them again.

In coloring slides drawing inks may be used and the surfaces so colored will not crack if the ink is applied in thin enough coats. Higgins's carmine will be found less suitable than the other reds because of its heaviness of body and rapidity of drying. A simple method of improving one's chances of securing a smooth result, however, is to soak the drafted slide in water and then allow it to dry until there is no free moisture present, until it is sticky, before the colors are applied. If these precautions are taken and the wash is not too thick an even uncracked surface will result. Water colors, especially the stains and "lakes," are highly transparent and generally preferable to many of the drawing inks. For blended outlines the colors should be put on while the slides are covered with water in the customary way, but for the sharp outlines which will usually be desired in drafted slides the latter should be approximately or entirely dry.

Lantern slides prepared in this way need not be covered to preserve the writings or figures from abrasion, always a troublesome feature when clear glass is used. Fingermarks will show, though a slide pinched between the fingers will take a mark more readily upon the clear than upon the coated side, but these can be removed from the latter, almost irrespective of the ink or coloring materials used, by washing with pure alcohol. The ounce of pre-

[5] Hite, B. H., Giddings, N. J., and Weakley, Chas. E., Jr., "The Effect of Pressure on Certain Microorganisms Encountered in the Preservation of Fruits and Vegetables," West Virginia Station Bulletin 146, 1914.